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THE
ANTHROPOLOGICAL REVIEW.
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ON THE LOCALISATION OF THE FUNCTIONS OF THE BRAIN WITH SPECIAL REFERENCE TO THE FACULTY OF LANGUAGE.

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The aim of modern science is most undoubtedly to unite branches of inquiry which have long been unnaturally separated. The most apt illustration of this tendency towards union between different branches of science, is the fusion which has recently taken place of the anatomist, physiologist, pathologist, psychologist, and physiognomist, into one homogeneous body. Long separated into different and frequently hostile camps, they have now united, leaving, we trust, all their squabbles and prejudices behind them. The good old word Anthropology is the banner under which this most desirable amalgamation has been effected. Not only, however, has there been a union of different branches of science, but we have had, at the same time, a junction of two opposite methods of scientific inquiry. The method of the modern anthropologist is neither purely inductive nor purely deductive. It unites in itself, as all genuine progressive science must do, both methods. The science of Anthropology rests on no narrow basis; its conclusions are not derived from any one branch of science. It leaves out nothing which is necessary to form a real science of man and mankind. Herein lies its power; and here, also, was doubtless the cause why it was so vehemently assailed when it first began to arouse the intellectual faculties of the races of Western Europe. The union of the anatomist, physiologist, pathologist, psychologist, and physiognomist, with the archæologist and ethnographer, has been effected amongst the *savants* of France, and is gradually being effected amongst their *confrères* in England, Germany, and America. If a method had been required to render the conclusions of Man-science unsatisfactory, none better could have been found than by separating the different branches of one science. This scientific revolution, by which a union of these sciences has been effected, is not confined to Europe, but is showing itself in nearly every part of the globe where science is at all studied. It is instinctively felt by the isolated students of different branches of the science of Anthropology, that only one desideratum to give their conclusions the weight and value they deserve is wanting, viz., a comparison of observations with other branches of the same science.

The subject of the present series of articles will serve as an illustration of the value of the union recently effected between the physiologist, pathologist, psychologist, and physiognomist. It will be seen that these are all names for parts of one and the same science—the science of human nature, now universally admitted to be properly designated by the word Anthropology. I shall have to draw illustrations for my subject-matter from each of these sciences. Why is it that psychology proper remains where it was two thousand years ago? Solely because she was too proud or too ignorant to call in aid of the physiologist and the pathologist. So, too, the nearly hopeless and chaotic condition into which the discoveries of Dr. F. Gall respecting organology have fallen is the result of, in the first place, insufficient foundation, and in the second, dogmatic teaching. Happily, most of the leading psychologists of Europe have seen and admitted the value of a union with the physiologist and pathologist. The discussions on the localisation of cerebral action before the Paris Anthropological Society, have inaugurated a new era in science—an era which cannot but have the most beneficial result; and it is most desirable that a similar era should be hastened in this country.

I shall not now stay to inquire whether physiology, pathology, physiognomy, or psychology, has contributed most to elucidate the subject of the localisation of the functions of the brain. I readily admit that each has contributed its fair quota, but most strongly insist that they are only rendered valuable when united into one science. It is only by surveying the rise and progress of our present knowledge, that we can really ascertain how far we are making an advance. While elated with satisfaction at our present progress, it behoves us well to remember how slow is the growth of all inductive sciences; at the same time, we cannot fail to observe how rapidly science advances when a true method has been obtained, and when we are able to shake off the yoke of traditional errors, against which, unfortunately, men of science have continually to struggle.

The contempt which scientific men now generally entertain for philosophy, is due, in a great measure, to the arrogant assumptions of a school whose disciples have not yet learnt that the age of speculative thought is passed, and that the present time is preeminently an age of science. The occupation of the dreaming theorist is gone, never, we trust, to return.

In the sequel, I shall have to touch on many points in mental science, such as Memory and Consciousness. These subjects appear, at first sight, to have but slight connection with the localisation of the faculty of Language, and yet it is necessary that we should comprehend what is meant by memory and other mental phenomena. Language is indeed only another word for thought; and without memory there could be no thought nor language.*

On this point I shall have to dwell at some length when I come to the most important question of a classification of the various forms of loss or defects of voice, articulation, speech, and language, which are associated with affections of the brain and the nervous system.

I need not now dilate on the vast importance of the subject in hand. Most cordially do I agree with Dr. Hughlings Jackson, when he says, "that to settle the position of one faculty, and especially of one so important as that of articulate language, will be a vast advance in physiological and psychological science."†

The many valuable works published on this subject, both in England, on the Continent, and in America, have hitherto mostly been considered from a purely pathological stand-point. My own treatment of the subject will be distinct in its method and aim from that of any other which has hitherto been attempted.

I have elsewhere,‡ some ten years ago, alluded to the researches of Dr. Bouillaud and M. Aequiel on certain morbid affections of the brain, and their influence on speech. M. Bouillaud at that time held that morbid affections of the anterior lobes of the brain alone affected speech; while M. Aequiel contended that disorganisation of nearly any portion of the brain has the same effect. At that date, however, the subject of the localisation of the faculty of language, as a pathological question, was not ripe for discussion. From a physiological or a physiognomical stand-point, the question remained much in the same state as it was left by Gall.

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* I here use the word *language* in its widest sense, almost synonymous with *expression*.

† *London Hospital Report*, vol. i, p. 464.

‡ *Philosophy of Voice and Speech*, 1859, p. 322. A second edition of this work is now passing through the press.

Ten years ago, there were comparatively few physiological writers who had given in their adherence to the doctrine of organology. I then alluded to the curious, if not remarkable fact, that such a distinguished physiologist as the late Sir B. Brodie, had, in his *Psychological Enquiries,* announced his grave suspicions that there was in the brain a special organ of speech. Brodie quoted two cases of young children who were unable to speak, although the intellectual faculties were seemingly perfect; and he thought himself both justified and compelled to assume the existence in the brain of a special organ for speech. This was the more extraordinary, inasmuch as Brodie had long been an avowed opponent of both Gall's organology and cranioscopy.

During the last few years, however, the aspect of the whole question has been changed. The localisation of the functions of the brain is not only one of the questions, but is, with many anthropologists, the most important question of the day.

For some years it has been my good fortune to be in intimate correspondence with one of the most accomplished of French anthropologists; one who takes equal rank as an anatomist, physiologist, or pathologist. I allude to my distinguished colleague Dr. Paul Broca, who, in 1861, revived, by some important observations, the discussion of this subject. It is at the urgent solicitation of this distinguished *savant,* that I have consented to write on a subject at once so difficult and complicated. There are, however, other reasons why I should take a deep interest in this question. I not only look upon the localisation of the functions of the brain as a most important question from a scientific point of view, but this subject has also attractions of a purely practical nature. I purpose now, however, to confine myself, as far as possible, to the bearings of this question on what is called Mental Science, or perhaps, more correctly, the science of Cephalonomy.

The functions of the brain, like the laws regulating the action of the larynx in the production of vocal sounds, are to be discovered only by means of physiology combined with pathology. Physiology and pathology are, indeed, but two branches of essentially the same science. My object is to ascertain the truth respecting brain functions, and not to dispute which line of inquiry has yielded, or is likely to yield, the most satisfactory data.

The localisation in the brain of any mental faculty, if once proved, will become the foundation on which mental science will have to be constructed. Let the ultimate decision be what it may, every anthropologist cannot but take a deep interest in a question on which hinge such important consequences. Physiognomy has not yet become a science; it now only consists of shrewd guess-work, and its professors do, perhaps, the cause of scientific inquiry as much harm as good. Physio-anthropology is, however, most undoubtedly the great science of the future. Should the mental faculties be localised in different parts of the brain, and should the practical physiognomist be able to discern their relative sites, then, and not till then, shall we become free from the assumptions of past and present ages, and have a solid foundation, on which we may confidently base a real science of Man. This subject requires students and not professors. Each student must look back to the past for such light as he can obtain, and this cannot fail to assist him in his future observations and reflections.

In attempting to give anything like an historical summary of the theories promulgated concerning the relations of the human body and mental phenomena to the localisation of the functions of the brain, it is necessary to go back at least three thousand years. This announcement need not, however, cause alarm. Many centuries will not occupy as many lines; whilst four or five centuries will, from want of material, be entirely passed over.

First of all, a few words on the Psychology of the Bible. Many learned works have been written on this subject; and if I cite only one, *The System of Biblical Psychology*, by Prof. Delitzsch,* of Erlangen, it is because I fully agree in what he says in his preface, that the psychology of the Scriptures need not feel ashamed in the presence of modern psychology. In saying I agree with him in this respect, it may hardly be necessary to state that I mean *pure* psychology.

In the psychology of the Bible, we meet with the tripartition of the soul, or a *trinitas mentis*, which pervades not only Greek, but, to some extent, modern psychology. Thus, the *ruach*, *nephesh*, *neshama* (breath of life), *leb*, spirit, soul, heart, represent the Hellenic *nous*, *logos*, *cardia*. The heart plays in Biblical, as well as in most heathen psychological systems, the chief part. There is, however this difference, that, in the Old Testament the heart is not merely looked upon as the most important vital organ, but as the organ of thought, volition, and as the seat of all emotions. The head and the brain scarcely find a place in the Old Testament. According to Delitzsch, the head, as the seat of the intellect, occurs only in *Daniel*:—" The dream and the visions of my head are these;" " Daniel had a dream and vision of his head;" " and the visions of my head troubled me."

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* *System der Biblischen Psychologie*, Von F. Delitzsch: Leipzig, 1855; translated into English, and published by Messrs. Clark.

It is quite evident that the doctrines of Pythagoras concerning the soul, form the basis, not merely of the theory of the ancient, but of comparatively recent psychologists. He divides the soul into two portions, the rational soul and the irrational; the former having its seat in the brain, the latter in the heart. But other writers ascribe to Pythagoras the doctrine of a tripartite division of the soul, as we find it in Plato. The division consists in the portion peculiar to man, *phrenes;* the animal portion, *nous*, and *thymos.* Later writers divide the irrational soul into the *thymos*, into the concupiscent, and aversive or irascible portion; the latter having its seat in the liver, the former in the heart. This was, we believe, the first attempt to localise the mental functions in different parts of the body.

Hippocrates,* the celebrated founder of therapeutics, the immediate predecessor of Plato as an author, considers, in his treatise of the glands, the brain as a gland. "The head," he says, "has glands; the brain itself resembles a gland. It is white, it is separated in small masses, like other glands. It possesses the same advantages. . . . . The brain is large, and lodged in the cranium, where it occupies much space. . . . . When the brain is irritated, consciousness is lost, the brain becomes convulsed, and involves the whole body. Man can no longer speak. He becomes suffocated and falls into a condition called apoplexy."

Again, in his work on epilepsy, we find the following remarkable passages as regards the functions of the brain, showing that he deemed it the seat of all the mental phenomena:—"It is necessary to know that man has only pleasure, gaiety, laughter, by the brain. From the same part come also pain, trouble, and inflictions. By this part we are wise, intelligent, we see, and hear, and discern what is good and bad, what is agreeable or disagreeable. . . . . It is by the brain that we fall into delirium and insanity, that we feel terror and fear by day or in the night, by dreams or errors of all kinds."

This, it will be admitted, is pretty strong language in favour of the brain being the seat of the so-called "mind;" but it is neutralised by another strong passage in his book on the heart. "The human mind is placed by nature in the left ventricle, whence it governs the rest of the soul." It may, however, be stated that the treatises *De Glandulis* and *De Corde* are attributed to the son or son-in-law of Hippocrates, and there are doubts whether Hippocrates is the author of the treatise *De Morbo Sacro.*

Plato distinguished in man what is corporeal and mortal from the soul, which he considers an eternal and self-acting energy, acting upon the human body, which is only its passive subject. In its connection with the body, he distinguishes, in two parts, the rational soul, created by the Supreme God, and which is immortal, and the irrational, formed by the generated gods (the demons). But as the mortal cannot combine with the divine, there is required a *tertium quid*, a sort of middle term which connects them; this is the *thymos*. The rational soul, he contends, has its seat in the brain; the irrational, or vegetative soul, which needs food for its preservation, has its seat between the diaphragm and the navel; the irascible soul or the spirit (the intermediate link between the mortal and the immortal soul, θυμος*), has its seat in the heart. The liver, in which the thoughts issuing from the brain are, so to speak, reflected as in a mirror, is the seat of the faculty of prophesying. The spleen, which is closely connected with the liver, is a sort of reservoir of the impurities of the blood.

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* Born 460 B.C.

According to Aristoteles, the soul is the entelecheia of organic bodies. In plants, the soul works as a preserving and nourishing energy (*anima vegetativa*), as the plant has no other functions than nutrition and propagation. In animals, the soul becomes sensitive (*anima sensitiva*), whilst the human soul is, at the same time, vegetative, sensitive, and cognitive (*anima rationalis*). Man thus being the end of nature, exhibiting, in himself, the various steps of development in nature. But as all consciousness ceases with death, the soul has, after death, no personal existence; but the entelecheia exists only as a divine absolute force, which, combining again with an animated human body, renders it a rational man, but who has no recollection of a former existence.

Aristotle further says that the brain is a compound of water and earth; that it is the most bloodless substance of the body; that it produces no sensation when touched, and that, being extremely cold, it moderates the heat of the heart. When the brain becomes too moist or too dry, it either does not refrigerate the heart or congeal the humour. He places the sensitive mind in the heart.

Mr. G. H. Lewes says,† "Instead of conceiving life as one of the manifestations of mind, Aristotle taught the precise obverse, namely, that mind is only the highest development of life."

For many centuries the teaching of Aristotle was accepted as that most in accordance with Christian doctrines. Whether this be so or not, it is equally certain that the tendency of all modern inquiry and research is to again bring us back to this doctrine. Sensation, motion, consciousness, and intellect, are now generally held to be in strict accordance with the development of nerve tissue and its consequent nervous force.

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* Θυμος is differently rendered by translators, owing to the word conveying different meanings. Thus Schleiermacher renders it *Eifer* or *Muth*, zeal or courage; others translate it *heart* or *spirit*. In fact, under *Thymos* Plato comprises all the active mental faculties tending towards the formation of rational ideas.

† Aristotle, *A Chapter from the History of Science*, p. 225, 1864.

Mr. Lewes thinks, to use his own words,* that "there are one or two passages which raise a doubt as to whether Aristotle had made this point clear to himself in the sense in which it is held by the most advanced psychologists; indeed, it is evident that he had but imperfectly appreciated the necessary correlation between an ascending complexity of organisation and an ascending complexity in vital phenomena, since he had not clearly and steadily mastered the fundamental relation between organ and function. Nevertheless, if he sometimes stopped midway, if he wavered in his conception of the relation between organ and function, the majority of moderns, even physiologists, have not been less wavering, and he stands at the point of view now generally occupied by the most advanced thinkers."

Erasistratus and Herophilus deserve a passing notice, as the founders of cerebral anatomy and physiology, and as the greatest ornaments of the celebrated Alexandrian School. We only speak here of Erasistratus as a cephalotomist, and his researches into the structure and functions of the nervous system. At first he believed that the nerves sprung from the *dura mater*, but on closer examination he discovered that they sprung from the substance of the brain. He moreover studied the convolutions and the ventricles of the human brain, and described and compared them to the brain of animals. Erasistratus assumed two kinds of spirits in the human body: the vital air, *pneuma zooticon*, resident in the heart, and soul, *pneuma psychicon*, resident in the brain. Some later authors also say that he distinguished between nerves of sense and of motion, and that he had a knowledge of the circulation of the blood.

Herophilus was probably a few years older than Erasistratus, and equally, if not more illustrious, than his contemporary. It is certain that he and Erasistratus dissected human bodies. Celsus says that Herophilus dissected the bodies of criminals alive, as is said of the anatomists of the sixteenth century. The most important discoveries of Herophilus relate to the functions of the nervous system. He considered the nerves as organs of sensation. That some nerves were subject to the will, and that these arose from the brain and spinal cord. He carefully dissected the brain, and the confluence of the occipital sinuses is still called *torcular Herophili.* He assumed four fundamental life forces: the nourishing (situated in the liver), the heating (heart), thinking (brain), feeling (nerves). In this respect he seems to follow Aristotle. So great was his reputation that a great anatomist of comparatively modern times considered him infallible.

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* *Vide* p. 224.

Galen was intimately acquainted with all the discoveries of his predecessors. He examined all the nerves, both as regards their origin and their termination. Thus he followed up the vagus to the lungs and the stomach, and made experiments on animals to prove the importance of that nerve in the production of the voice. He not only was very near describing the circulation of the blood (Hecker, Berl. 1811), but also very near the discovery of Sir Charles Bell in distinguishing the sensitive from the motive nerves. Galen derives from the brain all nerves for sensation, and from the spinal cord all motor nerves. Some nerves become, in their progress, motor nerves.

The organs of the rational soul are the brain and the nerves. The vital spirit, *pneuma zooticon*, has its seat in the heart and the arteries, and the natural spirit, the *pneuma physicon*, in the liver and the veins, The heart he, therefore, considered as the seat of courage and wrath, the liver as the seat of love. He rejects the opinion of Aristotle that the brain was subservient to the cooling of the natural heat of the heart.

As regards the mental functions, they are performed by means of the *pneuma*, which is prepared from the vital spirit, and is carried to the brain with the blood. Hence it is comprehensible how the soul changes with the body, and how all ideas and representations of the mind are merely the result of the disposition of the body.

Some place the chief part of the soul (what the Greeks call ἡγεμονικον,) in the heart; others in the membranes of the brain; others in the brain itself. Hence they all differ as regards the special use of these parts.

One passage more, to show that Galen considered the brain as the organ of intelligence, must suffice.

The brain, as regards its substance, resembles that of the nerves, of which it is the organ, only that it is softer. This is as it should be, for it receives all sensation, all imagination, and conceives all intelligence, and is more easily affected; for what is soft is more easily affected than what is hard.

Avicenna* assumed three kinds of spirits in the body: the natural, the vital, and the animal. Each of these is produced from the vapour of the blood. He also assumed nine animal faculties; five of which corresponded to the number of the external senses from which the mind receives its sensations. He establishes one faculty which sets the muscles and the limbs into motion, and three other faculties which preside over the imagination, memory, and reasoning. Roger Bacon was, to a great extent, a follower of Avicenna.

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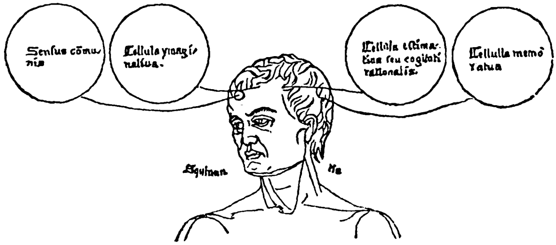
* See J. Conr. Barchusen, *Historia Medicinæ*, Amst. 1710.

Albertus Magnus looked upon the *sensus communis* as partly a particular sense which receives the forms of sensual objects, and partly as the common fundamental sense, the point of union of the sensations (consciousness). The mere capacity to receive impressions and forms of sensible objects is passive. The active power is distinguished in memory, imagination, and poetical force, which depend upon an internal spiritual organ. Albert assigns different spots in the brain as the seats of the above faculties. The *sensus communis* is situated in the brain, where the five senses terminate in a centre, and thus form an organ common to them all. Behind it is situated the faculty of imagination. Poetry has its place in the most central ventricle, and if this portion of the brain is injured, mania and rage are the result. Albert denied the world-soul, and the emanation of the soul from God. The soul is a simple, indivisible, unchangeable substance, which contains the principle of different faculties. The connecting medium of soul and body was the most imperfect part of the soul, and the most perfect of the body.

The revival of anatomy may be said to have commenced, at the beginning of the fourteenth century, with Luigi Mondini de Luzzi (*Mundinus* or *Mundinius*). Mondini's father was an apothecary at Bologna, probably the birth-place of Mondini; but in what year is not certain. We find him Professor at Bologna in 1314. In 1315, he publicly dissected two female bodies; and not long after published a treatise on anatomy, which became a text-book in the medical schools for nearly three centuries; for, at the end of the sixteenth century, it was the only text-book used in the University of Padua. This compendium (*anathomia*) was probably the first anatomical treatise illustrated by woodcuts; and was held in such esteem, that deviations from his descriptions were considered abnormal. As to the work itself, every page shows that the author, even after personal inspection, cannot escape from preconceived opinions and theories.

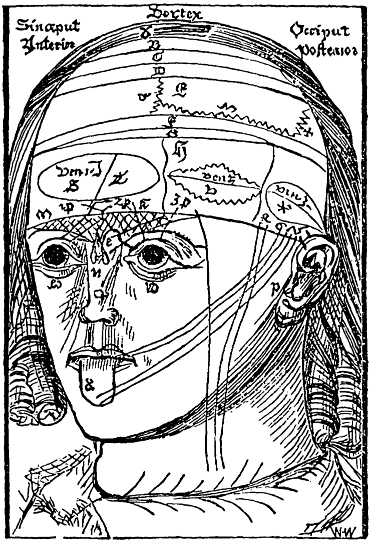
The first edition bears the title, *Anothomia* (sic) *Mundini præstantissimimorum doctorum, &c. Impressa Papaia*, 1478, *per Magistrum A. de Carcano.* This edition has no woodcuts. The illustration here



given is taken from the tract of Mundini published by Johann Ketham, in his work entitled, *Fasciculus Medicine compositus per excellentissimum artium ac medicine doctorem joānem de Kethem Allamanus. Venetiis*, 1495.

This work is remarkable for its excellent woodcuts, considering the period, and is generally held to be the first work illustrated by anatomical plates. One of the tables represents Mundinus lecturing in an anatomical theatre, surrounded by anxious students. A dead body lies on the table ready to be dissected.

Hundt (*Magnus canis*), born at Magdeburg (hence he is also called Parthenopolitanus) in 1449, studied at Leipzig, and became Rector of that University. He then took the degree of Doctor of Medicine, and subsequently that of Doctor of Theology, and became prebendary of the cathedral of Meissen, where he died in 1519.



Hundt* was one of the last famous Leipzig scholastics. He was equally distinguished for the extent of his knowledge as for his private character, and was the author of numerous works on grammar, philosophy, the canon law, and some of which were published.

The chief work of Hundt, which, even at present, is not without interest, both on account of its having given an impulse to the study of anthropotomy, and because of its being one of the first books published with anatomical woodcuts, bears the following imposing title, which we give at length:—"Anthropologium de hominis dignitate natura et proprietatibus, de elementis, partibus et membris corporis, de juramentis, nocumentis, accidentibus, vitiis, remediis, et physionomia ipsorum, de excrementis et exeuntibus, de spiritu humano ejusque natura, partibus et operibus, de anima et ipsiis appendiciis. Per Magnum Hundt Parthenopolitanum. Ingenuarum artium Magistrum in gymnasio Liptzensi. Ad laudem Dei et communem studiosorum hominem utilitatem quam accuratissime ex philosophorum congestum. Impr. Liptzick per Baccal. Wolf. Monacensem 1501. 4to." There is no doubt that Hundt was one of the first authors of modern Europe who used the word anthropology; and this will be sufficient to cause him to be gratefully remembered by the future historian of anthropological science.

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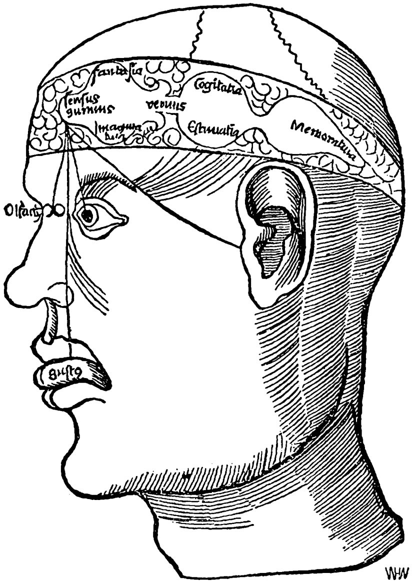
* The anonymous author of a work, *Centuria Scriptorum Insignium*, etc., (ed. a Joach. J. Madero, Helmst., 1660, 4to, enumerates a great many of Hundt's writings.

George Reusch, also called Gregorio Reisch, or Gregorius Rischius Carthusianus, was born about 1470-80, at Balingen, in Würtemberg. He subsequently became prior of the Carthusian convent at Freyburg, in Bresgau, and enjoyed great authority under Emperor Maximilian I, whose father confessor he was, and at whose death he was present.

The celebrated Dr. Johann Eck, the most violent opponent of the Reformation, went to Freyburg to study mathematics under Reisch.

It is singular that Reisch is scarcely mentioned in any of the biographical dictionaries, nor in encyclopædias; yet he must have been one of the most learned men of his time. His chief work, *Margarita Philosophica*, although consisting of only one volume, is a cyclopædia in miniature; and was, in fact, published later under the title of *Encyclopædia*, and one of the first books published under that name. This rare work is, as far as we know, the third anatomical book illustrated by woodcuts. Ketham's *Mundinus*, 1478, Hundt's *Anthopologium*, 1501, *Margarita*, 1503. The edition now before us is of 1508. We give the head, which is almost mapped as a phrenological bust of the present day. The engraving has been published by several authors, but has always been attributed to Baptista Porta, whose work was not published till 1583. We have not seen it mentioned in Porta that the illustration, which is, in fact, a fac-simile, was taken from the work of Reisch. Ludovico Dolci published this figure in his Dialogues, in 1562, but the engraving is somewhat reduced, and the tongue is out. There is little or nothing to be learnt from these works besides what we learn from the engravings themselves. *Margarita* says the number of internal senses are five: common sense, imagination, estimation,



phantasia, or imagination and memory. The common sense is in the first portion of the anterior ventricle, as is also the power of imagination. In the middle ventricle is the estimativa, and in the posterior, the memorativa. The word *vermis* (worm) will probably puzzle many modern anatomists, if not scholars. As used by Mundinus, it means the worm-like passage between the anterior and the middle ventricle, so that the spirits may pass from one ventricle to the rest. In Dolci's figure the following explanation is given. Hortensius (in the usual dialogue form) says, as the teacher, "You see in this figure where is the common-sense, where is the imagination, where the estimative power, where the power of memory, and also where is smell and taste." Fabricius (the pupil) answers, "I see all this remarkably well, and everything is put in its proper place."

J. Baptista Porta was born at Naples about 1550. He was, to judge from his numerous works, a most erudite physiognomist, deeply read in the works of his predecessors. His chief book, *De Humana Physiognomia,* published in 1586, has been translated into many different modern languages. He closely follows Aristotle and Avicenna, and considers that the human face should be compared with that of animals. No part of the human body is passed over. The woodcut representing the human head, with the distribution of the mental faculties, is, as already stated, without acknowledgment, taken from the *Margarita Philosophica* of Reusch.

Andreas Vesalius was one of the first who tried to shake off the yoke of Galen. He was a pupil of the celebrated Sylvius, who afterwards became his violent opponent, and described him as a mad reformer, because he dissented from Galen. His greatest work (*immortale opus,* Haller), is his *De Humani corporis fabrica libri VII.* Basil, 1542." Burggraeve (*Etudes sur Vesale*) says, "Vesalius has not enriched anatomy, he has created it." This is doubtless an exaggeration; but there is no doubt that the anatomical illustrations of Vesalius' works, drawn by great artists,—probably by Johann von Kalcker, a pupil of Titian, if not by Titian himself—some say also by Michael Angelo—have been copied in almost all the anatomical works of the sixteenth century.

Of his physiology of the brain, we may merely mention that Vesalius well distinguished the grey or cortical substance from the medullary substance; he described the ventricles more correctly, denied that smell had its seat in the anterior cornu of the ventricle. He endeavoured to establish that the use of the ventricles was chiefly to act as reservoirs for the animal spirits. He described the choroid plexus, the septum lucidum, and the fornix.

Although the knowledge of the structure of the brain, and the distribution of the nerves greatly advanced, the old theory of Galen still prevailed, that the animal spirits were secreted in the ventricles, and that the blood, intermixed with vital spirits, was, through the gyri of the brain, poured into these ventricles for the production of the animal spirits.

Chanet says*: "The first internal faculty to which the species are carried by the spirits is called *sens commun.* This *sensus communis* does not mean what is vulgarly called common sense, natural sense, natural logic, as opposed to artificial logic as taught in the schools. Thus, we say a man is a sensible man, which is synonymous with a clear-sighted, a reasonable, or rational man. The school-men, following Aristotle, say that *sensus communis* is the centre, where all the reports of the external senses are carried to."

Speaking of imagination, he says:—

> "The images being brought by the spirits (nerves) to the interior ventricle of the brain, excite the faculty which here resides. It is called imagination because it receives and discerns the images of all external senses. It is for her that memory preserves the images, to give them back to her for making new representations. The Greeks called it phantasia. Aristotle derives this term from a word signifying light: light standing in the highest relation with the sensitive soul, which resides in the brain. Imagination, some say, is the action of the imaginative faculty. This faculty is, properly, what people call *esprit*, or, as the Romans called it, *ingenium.* As the mind can have no new *sensation* but by the intermediation of the senses, which originally is due to the motion of certain fibres, its *reproduction* by the imagination depends still on the motion of the same fibres.
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> "All accidents which affect the body may weaken and destroy the imagination and the memory. Both have, therefore, their seat in the body.
>
> "The sensory fibres are so constructed, that a more or less continuous action upon them by objects produce more or less durable determinations, which constitute the *physic* of memory.
>
> "The condition of the fibres upon which an object has acted is no longer the same as it was before; but the fibres have been modified. It is impossible to say in what this modification consists. The tenacity of memory depends on the special disposition of the elements to retain the determinations imprinted upon them. An intelligence fully acquainted with the whole mechanism of the brain could read it like a book. The prodigious number of minute organs appropriated to sensations and thoughts would be, for such an intelligence, what, for us, are printed characters. We turn over the leaves of books; we study them. The aforesaid intelligence would merely contemplate the brains.
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> "I say nothing of *traces* and *delineations* in the brain which are so

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* *Traité de l'esprit de l'homme,* par le Sieur Chanet, Paris, 1649.

gratuitously assumed when the question is of memory. I confess I can form no idea of this, and consider it, therefore, more philosophical to admit that the same organs which, acted upon by objects, yield so diversified perceptions, are so constructed that their constituent parts receive from the action of objects such modifications, whence results a tendency to move in a certain direction from habit."

Imagination, he contends, resides in the fore-part of the brain. He gives a variety of reasons, the chief being that, after a strong effort of the imagination, we feel a lassitude, and considerable heat in the forehead. He, however, cautions his readers not to think that the imagination resides in an indivisible point of the brain, or is attached to a single spot, but its locality is more extended. "*Anatomy*," he observes, "*shows that the brain is composed of a number of small organs, we see dispersed in different parts of the brain, though we may not know the use of these different parts.*" The date of this, it is well to remember, is 1649, or a century and a-half before the time of Gall. Our author then proceeds to the organ of *memory.* He is afraid that he may be accused of using improper terms in attributing an organ to memory, which has no action and is, properly speaking, no faculty. Be that as it may, it has a passive instrument, a particular portion of the brain where the species are arrested and fixed.

"I hold," he says, "with the common opinion that this part is the cerebellum. The proofs are, certainly, not so very strong in favour of this theory as I should wish. Still, they seem probable and must be accepted. I find them contradicted only by one surgeon, who boasts of having removed the cerebellum without any disorder of the intellect intervening. But this surgeon seems to belong to that class of vainglorious operators who brag of having removed large organs when they have only removed a few atoms. If he had simply said that memory had not suffered, I might have believed him; but to say that no faculty whatever was damaged, is to say that nature made an organ of no use. I believe, on the other hand, an author worthy of belief, who states that he found the cerebellum absent in a man who, during life, had little or no memory. What a marvellous composition must have, then, that organ which is the direct instrument of our mental operations! What would be our delight if the mechanism of this masterpiece of the Omnipotent were displayed before our eyes! We should behold in this organ a little world; and if it belonged to a Leibnitz, this little world would be the abstract of a universe."*

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* The celebrated Hooke, on the supposition that an idea may be formed in twenty tierces of time, found that a man would, in one hundred years, collect 9,467,280,000 ideas, or vestiges; and if we were to reduce this sum to one-third on account of sleep, there would still remain 3,155,760,000 ideas; and supposing that there are two pounds of medulla in the brain, one grain of this medulla would have 205,452 vestiges (*Phys.*, Haller, t. v, lib. xvii, § vi). Much more wonderful would it appear when the vestiges, of which Hooke speaks, only reside in a very minute portion of the brain, and not in a considerable mass of this viscus. We might as easily apply it to one grain of this mass. Our imagination cannot seize such objects.

These views of Chanet, more than two centuries old, are both interesting and important. They illustrate the truth of the maxim, that "there is nothing new under the sun;" and demonstrate, if any such proof were needed, that the theory of the localisation of the functions of the brain is not a new discovery. It is, however, of less importance to the student of science to know whether it be new provided it be true.

There is a manifest disadvantage in treating a subject like the present in detached portions. Although, however, it has its drawbacks, it is really at present the only practical way of at all successfully treating the subject in hand. The question of the localisation of brain function is growing from day to day; for no sooner is a work published giving the latest results, than it seems out of date. I purpose, in this series of articles, to give a general sketch of the whole subject, with a digest of the present state of the controversy respecting the localisation of one of the mental faculties; and we shall then be better able to continue to give, from time to time, new facts that may be acquired either for or against this important theory.

[*To be continued.*]

ON THE MEASUREMENT OF CRANIA.*

By **Jeffries Wyman**, M.D., Hersey Professor of Anatomy in Harvard College, and Curator of the Peabody Museum of Archæology and Ethnography; Corresponding Member of the Anthrop. Society of London.

Tiedemann appears to have been the first to attempt anything like an extensive comparison of human crania based upon their capacity.† To this end, 1, he weighed the skull without the lower jaw; 2, filled the skull with dried millet seed and weighed again; 3, deducting the weight of the skull he obtained the weight of the millet seed filling it. Thus a means for determining the comparative size of the cranial cavity in different individuals or races was obtained, but it failed to give any exact idea of the volume of the brain. The method proposed by Sir William Hamilton was more successful; he filled the cranium with fine sand which was measured in cubic inches; having determined the weight of a cubic inch of sand, he multiplied this by the

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* Extracted from the *Proceedings of the Boston Nat. Hist. Soc.*, vol. xi, 1868.

† *Philos. Trans. of the Royal Society of London*, 1836, p. 497.